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WMO TROPICAL CYCLONE PROGRAMME: REPORT BY THE WORLD METEOROLOGICAL ORGANIZATION

Note by the Secretariat

The World Meteorological Organization (WMO) has submitted the attached report 1/ on its tropical cyclone programme, covering the period 1 July 1991 to 30 June 1992, for the information of the Committee on the Peaceful Uses of Outer Space. The report is available in English only.

Notes

1/ In view of the limited number of copies received, the report is distributed to the members of the Committee only.

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W O R L D M E T E O R O L O G I C A L O R G A N I Z A T I O N

Seventeenth Status Report on the Implementation of the WMO Tropical Cyclone Programme

(30 June 1991)

Introduction

1. Congress was saddened by the news of the recent major tropical cyclone disaster in Bangladesh. It noted the reports that the prevention measures taken by the Government, particularly cyclone shelters and the early warning system, significantly mitigated the number of casualties. It expressed its appreciation of the favourable results of support given by WMO under its Tropical Cyclone Programme (TCP), to the development of the warning system and, in this connection, with the great value of the frequent advisories provided by RSMC-tropical cyclones New Delhi to support the national Meteorological Service of Bangladesh in issuing very good forecasts and early warnings on this cyclone. Congress congratulated the Bangladesh Meteorological Department for the excellent work it had done in meeting its responsibility for the provision of warnings. However, Congress recognized that there is a pressing need for much more to be done and called for continuing and strengthened efforts under the TCP towards mitigation of disasters caused by tropical cyclones.

2. On reviewing the activities and developments under the Tropical Cyclone Programme, Congress expressed great satisfaction at the considerable progress made, since Tenth Congress, in both the implementation and further planning of the general and regional components of the programme. It commended, in particular, the Members participating in the work of the five regional tropical cyclone bodies and expressed its appreciation to them. Congress also acknowledged the valuable contribution of other WMO Members and the many national and international organizations, especially UNDP, ESCAP, UNDRO and LRCS, towards the implementation of the regional as well as the general components of the TCP. It learnt that Members concerned were particularly pleased with advances made in improvement of the operational tropical cyclone and flood forecasting and warning systems, in the provision of products to meet user requirements, in enhancing the response to warnings and in training of personnel under the programme. Congress noted with satisfaction the very important role played by meteorological satellites in the operational warning systems, particularly in the detection and monitoring of tropical cyclones. Congress also noted the important role of regional co-operation and co-ordination and of the three RSMCs with activity specialization in tropical cyclones, formally designated since Tenth Congress as RSMC Miami-Hurricane Center, RSMC-tropical cyclones New Delhi and RSMC Tokyo-Typhoon Center. It requested CBS to give early consideration to the recommendations of RA I and RA V that the centres in Réunion and Nadi respectively be designated as similar RSMCs. It further noted the progress in the establishment of additional flood forecasting systems and that procedures for management overview and monitoring of these systems have been instituted in most tropical cyclone regions.

3. Congress was particularly gratified by the valuable assistance provided through the WMO Voluntary Co-operation Programme and bilateral arrangements, which helped to accelerate the implementation of WWW facilities, on which the programme relies, and the training of personnel. Additionally, Congress recorded its appreciation for the considerable support with equipment, expert services, fellowships and group training provided by UNDP through inter-country projects to Members of four of the regional tropical cyclone bodies and that provided or soon to be provided by other funding agencies, particularly FINNIDA and the European Development Fund, to facilitate implementation of the programme.

4. Congress expressed its satisfaction with the active support that had been given by WMO to the planning and implementation of the International Decade for Natural Disaster Reduction (IDNDR) which had been launched by the General Assembly of the United Nations on 1 January 1990. It recognized that Meteorological and Hydrological Services had a critical role to play in national bodies and programmes established in support of the Decade. It endorsed the call made previously by the Executive Council for Members to become actively involved in, and contribute to, the work to achieve the goals of the IDNDR. At international and inter-agency levels, it was seen as important that WMO support Decade activities and to this end Congress adopted the WMO Plan of Action for the International Decade for Natural Disaster Reduction, with the understanding that the major part of the funding for the special projects for the IDNDR would come from extra-budgetary sources. In so doing, Congress requested the Executive Council to review and amend the Plan periodically and asked the Secretary-General to offer all possible assistance in its implementation. Congress was pleased to learn that the European Development Fund will be providing support for the development of the tropical cyclone warning system for the South-West Indian Ocean region and that this would contribute substantially to the implementation of the project on that subject in the WMO Plan of Action for the IDNDR. Congress recognized the need for co-ordination at both national and international levels in the planning and implementation of specific projects under the IDNDR.

5. Taking into account the support for the IDNDR that can be provided through the TCP, Congress requested acceleration of the activities under the programme and in particular those in disaster preparedness and prevention in co-operation with other organizations concerned, such as UNDRO and LRCS. Stress was placed on the high priority need to upgrade and improve the telecommunications systems in most regions, especially in the southern part of Region IV. Congress also requested intensification of work under the general component, including preparation and updating of guidance material and training of personnel. It agreed on continuation of the series of International Workshops on Tropical Cyclones to be organized as a joint activity of the Tropical Meteorology Research and Tropical Cyclone Programmes.

6. Congress requested that further steps be taken to strengthen the co-ordination among the regional tropical cyclone bodies, such as through meetings organized in a cost-effective way, which would also facilitate exchange of experiences, consideration of items of mutual concern and inter-regional co-operation. It noted that for the first time, a joint session of two regional bodies, the Panel on Tropical Cyclones and the Typhoon Committee, would be held in February 1992 and that Thailand had offered to host the session.

7. Concerning the tropical cyclone early warning systems, the importance of continuity of services and of contingency plans, to be put into effect when there are disruptions due to the cyclones or other causes, was stressed and commended to regional tropical cyclone bodies which have not already made adequate arrangements in this regard.

8. In the light of the humanitarian, social and economic impact of the TCP, and of its great potential for substantial contribution to the success of the International Decade for Natural Disaster Reduction (IDNDR), Congress decided that the programme should be further intensified and accelerated in association with the IDNDR and in accordance with the WMO Plan of Action for the Decade (see paragraph 4). Congress appealed to UNDP and VCP donor Members to continue and, where possible, increase the support provided and to other potential donors to provide support as needed to cyclone-prone Members in connection with TCP activities.

9. A draft of the sections on the TCP of the Third WMO Long-term Plan (TLTP) (1992-2001), Parts I and II which took into account the IDNDR, was developed by the Secretariat and submitted to Cg-XI. Emphasis was placed on promotion of transfer of technology and of public information and education. The draft was adopted by Congress in May 1991.

10. The TCP comprises two components: a general component concerned with methodology and transfer of technology and a regional component devoted to the activities of five regional tropical cyclone bodies.

General Component

11. The main activities under the general component continued to be directed at the publication of manuals and reports, which provide information and guidance to Members and thus assist them in the increased application of scientific knowledge and technological developments for the improvement of the warning and disaster prevention and preparedness systems. Under this component attention was also given to the broader aspects of training for the TCP.

12. A draft report on TCP Project No. 9 - "Tropical Cyclone Warning Systems" was edited and completed in November 1990. The report was published in late 1990 as a WMO Technical Document (WMO/TD-No. 394) in the TCP series (TCP-26) (see Appendix I, p. 5).

13. While the meteorological aspects of a draft report on TCP Project No. 14 - "Public Information and Education", which is being carried out jointly by UNDRO, WMO and LRCS have been completed, there is much work yet to be done on the disaster prevention and preparedness aspects and this report is not yet ready for publication.

14. A new project has been established as TCP Project No. 16 - "Global Guide on Tropical Cyclone Forecasting" to provide guidance and assistance to tropical cyclone forecasters in all tropical cyclone regions and basins. Various aspects of the project, including a work plan, were elaborated by an Expert Meeting on Preparation of a Guide on Tropical Cyclone Forecasting held in Manila in December 1989 in association with the Second International Workshop on Tropical Cyclones (IWTC-II). The detailed revised schedule for accomplishment of this project is set out in Appendix I, p. 7.

15. A draft report comprising the training material on the tropical cyclone forecasting system in the Panel area (Bay of Bengal and the Arabian Sea) on the use of the products of the RSMC - tropical cyclones New Delhi, compiled by Mr. G.S. Mandal (India) for his mission as consultant to the Panel countries in 1988 under the UNDP/WMO regional project was finalized. It will be published in the TCP series in September 1991.

16. Steps have been taken to organize the Third WMO International Workshop on Tropical Cyclones (IWTC-III) to be held in the Caribbean region in late 1993. An international committee for IWTC-III will be established in November 1991. It is expected to serve as a forum for the interaction between forecasters and researchers and encouraged the application of research results to operational usages.

Regional Component

17. Many activities were carried out under the regional component with a view to minimizing tropical cyclone disasters through close regional co-operation and co-ordination. Major emphasis was placed on improvement in the accuracy of the forecasts, provision of timely early warnings and on the establishment of the necessary disaster preparedness measures. Each of the tropical cyclone bodies had in place a formally adopted tropical cyclone operational plan or manual, aimed at ensuring the most effective cyclone forecasting and warning system with existing facilities, through co-operative agreement on sharing of responsibilities and on co-ordinated activities within the regions. Each of these bodies was giving attention to the implementation of their technical plan for future development of services to meet regional needs for upgrading forecasting and warning facilities and services for tropical cyclones and associated floods and storm surges, as well as for related disaster prevention and preparedness measures and supporting activities in training and research. In this regard invaluable assistance was provided through the UNDP regional projects for support to the programmes of four regional tropical cyclone bodies, i.e., the ESCAP/WMO Typhoon Committee, the WMO/ESCAP Panel on Tropical Cyclones, the RA V Tropical Cyclone Committee for the South Pacific and South-East Indian Ocean and the RA IV Hurricane Committee. Substantial progress was made in developments and improvements related to tropical cyclone forecasting and warning facilities and services through the provision, from the projects, of equipment, expert services, fellowships and group training.

18. The RSMCs with activity specialization in tropical cyclones in Miami, New Delhi and Tokyo demonstrated their functions and role as set out in their respective operational plans/manual at the CBS-Extraordinary session (London, September to October 1990). These served as examples for the demonstrations to be made by candidate RSMCs with activity specialization in tropical cyclones for the South-West Indian Ocean and for the South Pacific and South-East Indian Ocean at the next session of CBS.

19. Project proposals were formulated for three regional technical co-operation projects on mitigation of tropical cyclone disasters in relation to the IDNDR for inclusion in the UNDP fifth programming cycle (1992-1996) under the inter-country programme of its Asia and Pacific region. Three projects on similar subjects covering all cyclone basins have been formulated for submission to other potential donors.

20. An RA V/Tropical Cyclone Committee Implementation Co-ordination Meeting on the GTS was organized by WMO at the Headquarters of the Australian Bureau of Meteorology in Melbourne from 5 to 8 March 1991. It reviewed the present operational status of the point-to-point circuits called for in the regional meteorological telecommunication plan as well as radio broadcasts and recommended to establish GTS links of minimum speed 2400 bit/s between Melbourne-Nadi, Melbourne-Port Vila and Melbourne-Honiara, and to upgrade the link Melbourne-Port Moresby.

ESCAP/WMO Typhoon Committee

21. An operational typhoon field experiment (SPECTRUM) was carried out by Typhoon Committee Members during August to September 1990 to obtain enhanced meteorological observational data required for studies on the movement of tropical cyclones in the western North Pacific with a view to improving operational tropical cyclone forecasting. A SPECTRUM Technical Conference and Steering Group Evaluation Meeting which took place in Tokyo from 10 to 13 December 1990 concluded that SPECTRUM was an outstanding success, beyond expectations.

22. An annual activity report on typhoons for 1989 and for 1990 was published by the RSMC Tokyo - Typhoon Center and distributed to Typhoon Committee Members and other regional centres of the tropical cyclone bodies.

23. With the assistance of UNDP/WMO regional project funds, training activities were strengthened under the TCDC scheme, which included a forecaster exchange programme, attachment to advanced centres and also group training in improving typhoon warning services at the Japan Meteorological Agency.

24. In response to the request of the Committee, a consultancy mission team, comprised of experts on DPP and meteorological telecommunications, visited selected Committee Member countries during August to September 1990 and recommended measures to improve typhoon warning services in the region.

25. At the kind invitation of the Government of the Republic of Korea, the twenty-third session of the Committee was held in Seoul from 13 to 19 November 1990. It reviewed the substantial progress made since its last session in the implementation of its Regional Co-operation Programme, such as the installation or modernization of 15 upper-air observation stations, more than 24 cyclone detection radars and some satellite ground receivers and the upgrading of telecommunications systems. Several of these activities were carried out in preparation for SPECTRUM. It agreed that a project proposal in close relation to IDNDR on reduction of natural disasters related to typhoons and typhoon induced floods should be submitted to UNDP for funding under its inter-country programme for the 1992-1996 cycle (see paragraph 19 above). It made two specific proposals for enhancing co-ordination between TCP regional bodies: the convening of one of its annual sessions jointly with that of the Panel on Tropical Cyclones, possibly in January 1992 in Bangkok, Thailand, which is a Member of both bodies, and the holding of a TCP regional component co-ordination meeting once in every four years in conjunction with the IWTCs (see paragraph 16).

26. The award for 1990 of the annual Typhoon Committee Natural Disaster Prevention Award was presented at the Committee's twenty-third session to two recipients nominated by the Republic of Korea.

27. The fifth issue of the publication of the Typhoon Committee Annual Review for the year 1989, which had been compiled and finalized by the chief editor, designated by Hong Kong, in co-operation with the national editors, was widely distributed in late 1990. With financial assistance from the Typhoon Committee Trust Fund, the Typhoon Committee Newsletter No. 2 1990, prepared by TCS, was distributed to Members of tropical cyclone regional bodies and agencies concerned in early 1991.

28. A consultancy mission was carried out by Mr. Lim Joo Tick (Malaysia) to Member countries concerned from 3 to 23 June 1991 to prepare a UNDP/WMO regional project terminal report for the fourth UNDP programming cycle (1987-1991).

WMO/ESCAP Panel on Tropical Cyclones

29. Considerable progress in the implementation of the Panel's Technical Plan under its Regional Co-operation Programme was made during the past year as discussed at the Panel's eighteenth session (Maldives, January to February 1991). New installations included:

- cyclone detection radars: a 5 cm radar in Karachi, with support from Japan and a 10 cm Doppler radar in Thailand;
- high-gust anemometers: one set in Bangladesh with support from the UNDP/WMO regional project and four sets in India;
- a satellite receiver and image processor for NMC Colombo, Sri Lanka with assistance from the UNDP/WMO regional project;
- an upper-air observation station at Gan Island, Maldives under assistance of the TOGA project;
- a satellite link between RTH Bangkok and Yangon.

30. The first phase of the Panel's Regional Computer Network (RCN) project has been implemented with the installation of micro-computers and SHARE software together with the MSS-I telecommunication software at NMCs in Dhaka, Karachi and Colombo and with the training of staff. Financial support for the hardware, installation and training was provided from the UNDP/WMO regional project and the software was provided under the SHARE project. The MSS-I interfaces the RCN terminals with GTS circuits for real-time data entry. As a related development Bangladesh has initiated steps to upgrade the Dhaka-New Delhi circuit to a medium signalling speed by mid-1991. One fellow from Sri Lanka received training under the SHARE project during 1991. Maldives completed the installation of the Analyzing, Forecasting and Data-processing Operational System (AFDOS) in January 1991 with the assistance of the UNDP/WMO regional project. The software was provided by China under WMO/VCP assistance.

31. Within the framework of the Panel's Storm Surge Project and with the assistance of the UNDP/WMO regional project, a Regional Workshop on Tropical Cyclone and Storm Surge Forecasting was held in Colombo from 5 to 14 September 1990. In order to promote the linkages between the TCP regional bodies

and supporting UNDP/WMO regional projects in Asia and the South Pacific as well as to meet training requirements, forecasters from the Typhoon Committee and the RA V Tropical Cyclone Committee participated in the workshop. The workshop provided training for Class I and Class II meteorological personnel with a view to upgrading the forecasting and warning services for tropical cyclones and associated storm surges. Emphasis was placed on the application for this purpose of the micro-computer facilities installed under the regional computer network projects. The workshop achieved its objectives and formulated several recommendations which were endorsed by the Panel.

32. The telecommunications and electronics equipment expert (TEE) of the UNDP/WMO regional project carried out many missions to the Panel countries until termination of his duties in February 1991. He provided advice on and assisted in solving problems faced in the field of meteorological telecommunications and instruments and carried out on-the-job training at the national Meteorological Services visited. Based on his findings and recommendations, specific requirements from the Members were supported from the UNDP/WMO regional project funds to upgrade the facilities and services related to tropical cyclones.

33. The national project for the improvement of flood forecasting and warning services in Myanmar was completed. A project document has been prepared for hydrological forecasting in the Kelani River Basin in Sri Lanka.

34. The Panel News for 1990, prepared by the TSU, was widely distributed.

35. The RSMC - tropical cyclones New Delhi has commenced issuing "Tropical Weather Outlook" for the North Indian Ocean covering the Bay of Bengal and the Arabian Sea with effect from 31 August 1990.

RA I Tropical Cyclone Committee for the South-West Indian Ocean

36. In response to the request of the Committee, a new edition of the RA I Tropical Cyclone Operational Plan for the South-West Indian Ocean was published in late 1990, both in English and French, as a WMO publication (WMO-No. 618).

37. Regional Association I at its tenth session (Bamako, Mali, November to December 1990) re-established the RA I Tropical Cyclone Committee for the South-West Indian Ocean as a working group of the Association under the chairmanship of Mr. Y. Valadon (Mauritius). It adopted the Committee's Technical Plan and its Implementation Programme under Resolution 13 (X-RA I).

38. A proposal was submitted to the tenth session of Regional Association I to designate the Regional Tropical Cyclone Advisory Centre in Réunion as an RSMC with activity specialization in tropical cyclones. This centre and the two sub-regional Tropical Cyclone Advisory Centres in Madagascar and Mauritius carry out the regional functions and responsibilities set out in the Committee's operational plan.

39. A regional project for the South-West Indian Ocean region has been approved for financing by the European Development Fund (EDF) through the backing of the "Commission de l'Océan Indien". The agreement for financing the project through a loan of four million ECU and a donation of one million

ECU has been signed by all governments concerned. This may be the first time in the world of meteorology that governments at a regional level have accepted to borrow money to finance the development of their meteorological services.

40. Through bilateral assistance from FINNIDA and developed countries, the Members of the Committee on mainland Africa upgraded and strengthened their services.

41. In compliance with the meteorological component of the Committee's Technical Plan, upper-air stations in Mtwara and Kigoma of Tanzania and a DCP at Mutare of Zimbabwe were established.

42. The report drawn up by the Regional Tropical Cyclone Advisory Centre (RTCAC) in Réunion on the 1989/1990 cyclone season in the South-West Indian Ocean was sent to all the RA I Tropical Cyclone Committee Member countries as well as to a large number of international experts and specialized agencies concerned with cyclone prevention.

43. An exchange programme for forecasters was implemented during the peak season for tropical cyclones in early 1991 based on the detailed plan developed at the ninth session of the Committee (Zimbabwe, October 1989).

44. Arrangements are being made for the tenth session of the RA I Tropical Cyclone Committee for the South-West Indian Ocean to be held in Seychelles in October 1991 and for organizing an RA I Roving Training Seminar on Tropical Cyclone Forecasting at the Mozambique Meteorological Service, Maputo for English-speaking countries and at the Regional Tropical Cyclone Advisory Centre, Réunion for French-speaking candidates in October to November 1991.

RA IV Hurricane Committee

45. Supplement No. 2 to the Hurricane Operational Plan (1988 edition), which comprises changes to the text approved by the President of RA IV at the twelfth session of the Committee and amendments to the annexes provided by Members, was issued in late 1990 both in English and Spanish.

46. The continuation of the series of an RA IV Workshop on Hurricane Forecasting and Warning was implemented at the RSMC Miami - Hurricane Center from 18 to 27 March 1991 to train English-speaking and Spanish-speaking Class I and Class II hurricane forecasters. The workshop, conducted with interpretation in English and Spanish, was attended by participants from 19 Members of the Region. The workshop recommended that further workshops in this biennial series should be held in the future increasing the duration to ten working days and, at future such workshops, folders with hand-out material should continue to be provided and to the extent possible further expanded.

47. The implementation co-ordination meeting on the GTS in RA IV was held in Port of Spain, Trinidad and Tobago from 2 to 8 April 1991. The meeting elaborated a draft outline plan for the future regional meteorological telecommunication network in RA IV, based on two-way point-to-multipoint communication services via satellite. It concluded that the total current contributions from RA IV Members for the telecommunication services provided for ANMET, CEMET and some other low speed GTS circuits approximated the recurrent costs for the new satellite based network.

48. The Committee at its thirteenth session (Port of Spain, Trinidad and Tobago, 9-15 April 1991) supported the view of the above implementation co-ordination meeting that the proposed satellite based network would efficiently meet the requirements for exchange of meteorological data and products in a cost-effective manner, while more detailed planning is required, for example, on terminal equipment. It concluded that a meeting would be required to further develop the plan and to consider its implementation and financial aspects and, in particular, the cost sharing arrangements. Accordingly, the Committee, as a high priority item, invited the President of RA IV to request the Secretary-General of WMO to plan for such a meeting, to be held as soon as definite cost assessments are available, and prior to the award of the contract for the telecommunication service by the United States National Weather Service.

49. In compliance with the hydrological component of the Committee's Technical Plan:

- Two satellite based stations were installed in 1990 which significantly improved the flood warning system on the Magdalena and Cauca river basins in Colombia.

- The project for the optimization of water resources management system in the Yage del Sur River Basin in the Dominican Republic had successfully been completed.

- Agrometeorological and hydrometeorological studies were undertaken in Guatemala.

- Progress was made in Cuba and El Salvador in the training of personnel and model calibration which is now well advanced.

- Rapid progress has been made in Trinidad and Tobago on data storage and processing.

- A project document in respect of flood plain mapping and flood forecasting was prepared with the assistance of WMO and submitted to the relevant authorities.

- The remaining activities of the flood plain mapping project in Jamaica were completed, leaving behind an operational fully automatic flood forecasting and warning system in the pilot basin of Rio Cobre.

- Two major projects in Venezuela carried out hydrometeorological studies, expanded the network of hydrological stations, improved the tele-transmission and data processing systems, and developed support programmes of conservation and use of river basins, reservoir management and optimization.

- Major activities for the English-speaking Caribbean countries were undertaken in the fields of hydrological data processing facilities and in improvement of hydrological networks and training of personnel.

- A new project was to be implemented during the period 1991 to 1993 for the rehabilitation and improvement of Meteorological and Hydrological Services in Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama.

50. The Committee at its thirteenth session reiterated its wish that the Third International Workshop on Tropical Cyclones (IWTC-III) be held in its Region. In order to facilitate exploring possible host countries, the Committee requested that an aide-memoire be distributed on the facilities required to be provided by the host country to Cuba, Dominican Republic, Mexico and USA (Puerto Rico). It was agreed that Mr. Best (Barbados) serve as the Committee's representative on the International Committee for IWTC-III to be established on 1 November 1991.

RA V Tropical Cyclone Committee for the South Pacific and South-East Indian Ocean

51. The third biennial session of the RA V Tropical Cyclone Committee for the South Pacific and South-East Indian Ocean was held in Wellington from 27 August to 1 September 1990 with twenty-eight participants from eleven Members of WMO and six non-Members of WMO. The Committee reviewed in detail its Operational Plan and Programme for Future Development of Services and recommended improved measures for mitigation of the harmful effects of tropical cyclones through close regional co-operative and co-ordinated efforts.

52. As requested by the Committee at its second session (Brisbane, 1988), a Workshop for Senior Meteorological and Disaster Preparedness Officers from the South Pacific region was organized by WMO in Wellington from 30 August to 1 September 1990 in conjunction with the third session of the Committee, under the work plan for the UNDP/WMO regional project. The workshop promoted close linkages between meteorological services and disaster preparedness communities in the South Pacific region and made recommendations on measures to reduce tropical cyclone disasters, especially for the island countries in the South-West Pacific.

53. Also in response to a request at the second session of the Committee, an RA V Workshop on Tropical Cyclone Analysis and Forecasting was implemented in Vanuatu from 15 to 24 October 1990 with financial support from the UNDP/WMO regional project and the TCP. Twelve forecasters from Cook Islands, Fiji, Papua New Guinea, Tonga and Vanuatu attended under the directorship of an expert from Australia (Mr. F. Woodcock) and a team of resource specialists from Australia (Mr. J. Davidson and Mr. G. Bond) and Japan (Mr. T. Kikuchi). The workshop provided participants with training on technologies for upgrading the monitoring, forecasting and warning systems for tropical cyclones in the South Pacific through the exchange of knowledge and experience and practical training. It formulated some recommendations, based on the experience gained during the workshop,for modernization and improvement in tropical cyclone forecast and warning services, in particular by using a personal computer based workstation.

54. Supplement No. 2 to the Tropical Cyclone Operational Plan for the South Pacific and South-East Indian Ocean was issued in late 1990.

55. The Chief Technical Adviser, Mr. D. Roberts (New Zealand), under the UNDP/WMO regional project for the South Pacific, was attached to the Fiji Meteorological Service from 15 October to 7 November 1990 and 8 April to 18 May 1991 and assisted the Project Co-ordinator, Mr. R. Prasad (Fiji), in identifying the regional requirements and planning the development of the services in the region, including preparation of a draft terminal report of the UNDP/WMO regional project.

56. In accordance with the work plan for the UNDP/WMO regional project, Mr. G.A. Bond (Australia) and Mr. G. Holcombe (Australia) were attached to the Papua New Guinea Meteorological Service from 27 October to 25 November 1990 in order to review the tropical cyclone warning system of Papua New Guinea and to Fiji Meteorological Service from 18 February to 18 March 1991 in order to investigate appropriate measures for improving and developing the Fiji Meteorological Service, respectively.

Co-operation with other organizations

57. In accordance with the wishes of the WMO Congress, close co-operation with other international and regional organizations has continued. Thus there has been close consultation with ESCAP, UNDP, UNDRO, LRCS and other organizations, on a variety of matters of common concern. The main items include ESCAP's co-sponsorship of the Typhoon Committee and the Panel on Tropical Cyclones, UNDP's invaluable support through regional projects in four regions, as well as UNDRO and LRCS involvement in the disaster prevention and preparedness component of the TCP, in particular in the context of IDNDR.

58. Substantial progress has been made towards attaining the objectives of the TCP with support to the programmes of four regional tropical cyclone bodies, i.e., the ESCAP/WMO Typhoon Committee, the WMO/ESCAP Panel on Tropical Cyclones, the RA V Tropical Cyclone Committee for the South Pacific and the RA IV Hurricane Committee, being provided under regional projects in the fourth cycle inter-country programme of UNDP (1987-1991). The four regional tropical cyclone bodies involved have fully agreed that these are major steps forward and that such support has considerably assisted in the provision of the equipment, expert services, fellowships and group training which are essential for the further improvement of forecasting and warning services in their respective regions.

59. The TCP officer, as representative of WMO, made a presentation entitled "International Scope of Natural Disasters and the Collective Efforts of the WMO and Individual Nations towards Mitigation of Natural Disasters" at the Annual Conference of the National Weather Association (New Carrolton, USA, 15-19 October 1990).

60. A Workshop on Improving Cyclone Warning Response and Mitigation was organized by ADPC/AIT in Nadi, Fiji from 8 to 12 April 1991. The Chief Technical Adviser of the UNDP/WMO regional project for the South Pacific participated in the workshop as a guest resource person.

61. A Regional Seminar on Strengthening Disaster Management in the South Pacific was organized by UNDRO at the Forum Secretariat Headquarters in Suva, Fiji from 26 to 28 March 1991. Mr. R. Prasad (Fiji), Co-ordinator of the UNDP/WMO regional project for the South Pacific, attended the seminar as representative of WMO.

Programme for 1991-1992

62. The TCP covers a wide range of activities which are of a continuing and long-term nature. Preceding sections of this report contain an overview of several of the ongoing activities and, in some instances, indications have been given of the plans for the period ahead. The main parts of the 1991-1992 programme are set out below in summary form:

General component

(a) publication of the Third WMO Long-term Plan (1992-2001), Part I and Part II, Volume 1 - Tropical Cyclone Programme (see paragraph 9);

(b) publication of papers presented at the first SPECTRUM Technical Conference (see paragraph 21) and of training material on the tropical cyclone forecasting system in the Panel area and the use of the products of the RSMC - tropical cyclones New Delhi (see paragraph 15);

(c) as appropriate, preparation, editing, publication and distribution of reports under TCP projects Nos. 14 and 16 (see Appendix I, section B).

(d) training of personnel under the storm surge projects in Region IV (TCP project No. 13) and in the Panel region;

(e) formulation of new projects for the TCP proposed by the Third WMO Long-term Plan, Part II ;

(f) follow-up to SPECTRUM (see paragraph 21).

Regional component

63. Under the regional component, the programme will be mainly concerned with the activities undertaken by the five regional cyclone bodies and the implementation of the decisions they make. A provisional schedule for the period July 1991 to June 1992 of meetings and training events within or related to the TCP, is given below:

- Workshop on Tropical Cyclone Forecasting (Nadi, Fiji, 8-19 October 1991);
- RA I Tropical Cyclone Committee, tenth session (Mahé, Seychelles, 21-26 October 1991);
- RA I Roving Training Seminar on Tropical Cyclone Forecasting (Maputo, Mozambique, 28 October to 1 November 1991 for English-speaking countries; St. Denis, Réunion, 4-8 November 1991 for French-speaking candidates);
- Technical Conference on SPECTRUM (Guangzhou, China, 25-29 November 1991);
- Joint session of the WMO/ESCAP Panel on Tropical Cyclones and the ESCAP/WMO Typhoon Committee (Pattaya, Thailand, 18-27 February 1992);
- RA IV Workshop on Hurricane Forecasting and Warning (Miami, USA, tentatively April/May 1992);
- RA IV Hurricane Committee, fourteenth session (Belize City, Belize, 28 April to 4 May 1992);
- Roving Training Seminar on the DPP in the South Pacific (Rarotonga, (Cook Islands); Apia (Western Samoa); Suva (Fiji); Port Vila (Vanuatu), tentatively May/June 1992).

64. Important inter-sessional activities will include:

- as appropriate, preparation, editing, publication and distribution of new edition of the Tropical Cyclone Operational Plan for the Bay of Bengal and Arabian Sea, Region IV Hurricane Operational Plan (E and S), South Pacific and South-East Indian Ocean (E and F) and the Manual for the Typhoon Committee area;

- further development of the regional co-operation programmes of the five regional tropical cyclone bodies;

- planning for and implementation of phase 1 of the regional computer network projects for the RA V Tropical Cyclone Committee for the South Pacific and South-East Indian Ocean, RA IV Hurricane Committee and RA I Tropical Cyclone Committee for the South-West Indian Ocean;

- preparation and publication of Typhoon Committee annual review for 1990 and 1991;

- preparation and publication of the Panel News for 1990 and 1991;

- organization of RA IV Workshop on Hurricane Forecasting and Warning;

- follow-up to SPECTRUM (a special typhoon experiment) under the programme of the Typhoon Committee (see paragraph 21);

- execution of the management overview of flood forecasting systems (MOFFS) by Members of the regional tropical cyclone bodies;

- preparation and publication of manuscript on landslides;

and, in more general terms:

- publication of sections on the TCP for inclusion in the WMO Third Long-term Plan (1992-2001), Part I and Part II;

- implementation of the WMO Third Long-term Plan (1992-2001), Part II, Volume 1 - Tropical Cyclone Programme;

- implementation of the WMO plan of action for the IDNDR;

- continued activities for the implementation of the Regional Co-operation Programmes, Technical Plans and other work programmes of the regional cyclone bodies;

- work of study groups, sub-groups and rapporteurs established by the regional tropical cyclone bodies, e.g., research activities in each of the three main components of the Typhoon Committee's programme under the leadership of the Research Co-ordinators, SPECTRUM Research Co-ordinating Group, and the rapporteur on updating of the Typhoon Committee Operational Manual; the Panel's rapporteur on an operational cyclone field experiment for the Bay of Bengal and the Arabian Sea region; the RA I TCC's rapporteurs on evaluation of cyclone information exchange, telecommunications and climatology; the Hurricane Committee's studies on satellite-based telecommunications network in the region and on regional activities on storm surges;

- action on further proposals made by the Congress, the Executive Council, Regional Associations concerned and the regional tropical cyclone bodies.

APPENDIX I

WMO TROPICAL CYCLONE PROGRAMME - GENERAL COMPONENT

Status of Implementation on 30 June 1991

A. Projects completed or under which reports have been issued

Project number and title	Title of report and date of issue	Remarks
No. 1 - Special tropical cyclone observing network	"Special wind and pressure observing network" issued in September 1982.	
No. 2 - Observations from mobile ships	"Observations from mobile ships" distributed on 16 March 1977.	
No. 3 - Automatic weather stations	"Automatic weather stations for tropical cyclone areas" issued in July 1981	WMO Publication, in the TCP series (WMO-No. 570)*
No. 4 - Radar	"Weather radars for monitoring tropical cyclones" issued in December 1984	Published in the TCP series as report No. TCP-17
No. 5 - Geostationary satellites	"The use of Satellite Imagery in Tropical Cyclone Analysis" issued in November 1977	WMO Technical Note No. 153 (WMO-No. 473)*
No. 6 - Forecasting tropical cyclone intensity and movement	"Operational Techniques for Forecasting Tropical Cyclone Intensity and Movement" issued in August 1979	WMO Publication (WMO-No. 528)**
No. 7 - Storm surge prediction	"Present techniques of tropical storm surge prediction" issued in March 1978	WMO Publication (WMO-No. 500)*
No. 8 - Risk evaluation techniques	"The quantitative evaluation of the risk of disaster from tropical cyclones - report of a WMO/UNEP project on the meteorological and hydrological aspects" issued at the end of 1976. In English, Spanish, French	WMO Publication (WMO-No. 455) Spanish*

* Out of print
** Reprinted in 1989

Project number and title	Title of report and date of issue	Remarks
No.10 - Community preparedness and disaster prevention	"Guidelines for Disaster Prevention and Preparedness in Tropical Cyclone Areas" prepared jointly by WMO, ESCAP and LRCS and issued in English in June 1977 and in French and Spanish during the first half of 1978.	Published by WMO. Requests for copies may be addressed to WMO, ESCAP or LRCS Secretariats.
No.11 - Flood forecasting and warning	------	A joint ESCAP/WMO mission visited the Tropical Cyclone Panel member countries to assess facilities available and evaluate the improvements required. Significant progress has been made in improving hydrological facilities in the Typhoon Committee area. A roving seminar was organized to train local personnel in the analysis and prediction of intense precipitation and floods in Asia and S.W. Pacific.
No.12 - Human response to tropical cyclone warnings and their content	"Human response to tropical cyclone warnings and their content" issued in February 1983	Published in the TCP series**
No.15 - Typhoon Operational Experiment (TOPEX)	(See list below)	
	TOPEX Report No. 1 - "First Planning Meeting" issued in 1980	WMO Publication in the TCP series (WMO-No. 565)*.

* Out of print
** Reprinted in 1989

Project number and title	Title of report and date of issue	Remarks
	(TOPEX Report No. 2) - "TOPEX Operational Manual", issued in 1980, new editions issued in 1981 and March 1983.	Published in the TCP series.*
	TOPEX Report No. 3 - "TOPEX - a general description" issued in 1981.	WMO Publication in the TCP series (WMO-No. 573).
	TOPEX Report No. 4 - "Information on objective methods of typhoon track prediction being used operationally at experiment sub-centres, TOPEX Core Experiment", issued in May 1982.	Published in the TCP series.
	TOPEX Report No. 5 - "Second Planning Meeting", issued in June 1982.	Published in the TCP series.
	TOPEX Report No. 6 - "Evaluation report on the Pre-experiment for the Meteorological Component of TOPEX" issued in September 1982	Published in the TCP series.
	TOPEX Report No. 7 - "First Operational Experiment - Report of the International Experiment Centre" issued in March 1983.	Published in the TCP series.
	TOPEX Report No. 8 - "Third Planning Meeting" published in June 1983.	Published in the TCP series.
	TOPEX Report No. 9 - "A preliminary evaluation of the TOPEX First Operational Experiment - Meteorological Component" published in October 1983.	Published in the TCP series.
	TOPEX Report No. 10 - "Second Operational Experiment. Reports of the International Experiment Centre and of the Typhoon Tracking Experiments" published in December 1984.	Published in the TCP series.

* Out of print

Project number and title	Title of report and date of issue	Remarks
	"TOPEX Evaluation Meeting" published in March 1985	Published in the TCP series as report No. TCP-18
	"Activities under the Hydrological Component of TOPEX" published in May 1985	Published in the TCP series as report No. TCP-20
	"Counter-Attack; The Story of the Typhoon Operational Experiment" published in 1987	Published in the TCP series as report No. TCP-22

B. Other projects

Project number, title and objectives	Mode of implementation	Status
No. 9 - Tropical cyclone warnings Objectives: The production of guidelines describing the main principles and practical considerations to be followed in setting up a tropical cyclone warning system.	Revision and updating carried out by small group of experts: Mr. R. Falls (Australia) Leader, Mr. R. Lau (Hong Kong) Mr. J. Flores (Philippines)	Published in late 1990 in the TCP series as Report No. TCP-26
No.13 - Regional aspects of storm surge prediction (Caribbean, Central America and Eastern Pacific) Main objectives: a) to develop storm surge atlases for all the larger countries of the region that are substantially threatened by storm surges.	Members represented on the RA IV Hurricane Committee with assistance from the WMO Secretariat	Members of the Hurricane Committee to nominate further candidates to be trained and to develop the atlases

Project number, title and objectives	Mode of implementation	Status
b) to study the impact of the surge on small islands.		
c) to develop the capability of updating the models used to generate the atlases with a view to facilitating simulation exercises as well as revision of the atlases.		
d) to provide for training of personnel involved in the application of the atlases.		
No.14 - Public information and education		
Objectives:		
To prepare guidance and sample material to assist Members in the improvement of their public information and education programmes.	Joint WMO/UNDRO/LRCS project. Mr. E. Ressler (UNDRO/LRCS/WMO) Mr. H. Friedman (USA)	Meteorological aspects of the report have been completed. Some work has been done on the Disaster Prevention and Preparedness aspects of the report.

No.16 - Guide on Tropical Cyclone Forecasting

Objectives:

To prepare guidance and assistance to tropical cyclone forecasters in all tropical cyclone regions and basins.

August 1989	Editorial Group established.
August to October	Collection of current forecast manuals, development of overall manual structure.
November	Editors complete detailed draft of manual content.
December (immediately following IWTC-II)	Expert meeting on planning preparation of the manual, including finalizing contents.
January 1990	Expert meeting report, including recommended pro forma for draft chapters, distributed.
April	Authors to provide chapter outlines to Chief Editor, with all topic and sub-topic headings and point form descriptions as necessary.
March 1991	First drafts to Chief Editor.
October	Second drafts to Chief Editor.
January to April 1992	Review requested from ocean basin representatives, technical experts and others as desired.
May	Final copy to Chief Editor.

July	Submission of complete and final version to WMO.
September	Final technical editing and provision of camera-ready copy.
October	Publication by WMO and distribution prior to the Southern Hemisphere cyclone season.

APPENDIX II

TROPICAL CYCLONE PROGRAMME REPORTS

TECHNICAL DOCUMENTS (Programme Reports) -
TROPICAL CYCLONE PROGRAMME (TCP) Series

(including TOPEX report sub-series)

WMO-No.565*
(TCP-1) First Planning Meeting for TOPEX. TOPEX Report No. 1. 1980.

(TCP-2)* TOPEX Operational Manual (Core Experiment). 1980. Revised 1983.

(TCP-3)* Report on the WMO Workshop on the Use of Satellite Data for Hurricane Detection and Prediction. 1981.

(TCP-4) Tropical Cyclone Programme Plan of Action. 1981. E, F, R*, S.

WMO-No.570*
(TCP-5) Automatic Weather Stations for Tropical Cyclone Areas. 1981.

WMO-No.573
(TCP-6) Typhoon Operational Experiment - A General Description. TOPEX Report No. 3. 1981.

(TCP-7) Information on Objective Methods of Typhoon Track Prediction being used Operationally at Experiment Sub-Centres, TOPEX Core Experiment. TOPEX Report No. 4. 1982.

(TCP-8) Second Planning Meeting for TOPEX. TOPEX Report No. 5. 1982.

(TCP-9) Report on the WMO Seminar on the Application of Satellite Data to Tropical Cyclone Forecasting. 1982.

(TCP-10) Evaluation Report on the Pre-Experiment for the Meteorological Component of TOPEX - TOPEX Report No. 6. 1982.

(TCP-11) Human Response to Tropical Cyclone Warnings and their Content. 1983. Reprinted 1989.

WMO-No.618
(TCP-12) Tropical Cyclone Operational Plan for the South-West Indian Ocean. 1983*. New Edition 1990. E, F.

(TCP-13) First Operational Experiment - Report of the International Experiment Centre. TOPEX Report No. 7. 1983.

(TCP-14) Third Planning Meeting for TOPEX. TOPEX Report No. 8. 1983.

(TCP-15) A Preliminary Evaluation of the TOPEX First Operational Experiment - Meteorological Component. TOPEX Report No. 9. 1983.

* Out of print

(TCP-16)	Second Operational Experiment. Reports of the International Experiment Centre and of the Typhoon Tracking Experiments. TOPEX Report No. 10. 1984.
WMO/TD-No. 8 TCP-17	Weather Radars for Monitoring Tropical Cyclones. 1984.
WMO/TD-No. 21 TCP-18	TOPEX Evaluation Meeting. 1985.
WMO/TD-No. 26 TCP-19	Report of the Seminar on the Application of Radar Data to Tropical Cyclone Forecasting. 1985.
WMO/TD-No. 37 TCP-20	Activities under the Hydrological Component of TOPEX. 1985.
WMO/TD-No. 84 TCP-21	Tropical Cyclone Operational Plan for the Bay of Bengal and the Arabian Sea. 1986. New edition 1991.
WMO/TD-No. 185 TCP-22	Counter-Attack: The Story of the Typhoon Operational Experiment (TOPEX). 1987.
WMO/TD-No. 196 TCP-23	Typhoon Committee Operational Manual - Meteorological Component. 1987.
WMO/TD-No. 292 TCP-24	Tropical Cyclone Operational Plan for the South Pacific and South-East Indian Ocean. 1989. E, F.
WMO/TD-No. 327 TCP-25	Some Aspects of Flood Forecasting Systems in Asia, 1984 to 1988. 1989.
WMO/TD-No. 394 TCP-26	Tropical Cyclone Warning Systems. 1990.

OTHER RELEVANT PUBLISHED REPORTS

A. TCP Projects

WMO-No. 455 Special Environmental Report	The Quantitative Evaluation of the Risk of Disaster from Tropical Cyclones. 1976. E, S*, F.
WMO-No. 473* Technical Note No. 153	The Use of Satellite Imagery in Tropical Cyclone Analysis. 1977.
ESCAP, WMO, LRCS	Guidelines to Disaster Prevention and Preparedness in Tropical Cyclone Areas. Geneva/Bangkok, 1977. E, F, S.
WMO-No. 500* Marine Science Affairs	Present Techniques of Tropical Storm Surge Prediction. 1978.
WMO-No. 528 World Weather Watch	Operational Techniques for Forecasting Tropical Cyclone Intensity and Movement. 1979*. Reprinted 1989.

B. TCP Regional Bodies

WMO-No. 524 World Weather Watch	Regional Association IV (North and Central America) Hurricane Operational Plan. 1979*. New Editions 1985*, 1988. E, S.
WMO, ESCAP ESCAP/WMO Typhoon Committee	Symposium on Typhoons. 1980*.
ESCAP/WMO Typhoon Committee	ESCAP/WMO Typhoon Committee Annual Review for 1985. 1986. 1987. 1988. 1989. Five reports, issued in each case in the following year.
WMO/ESCAP Panel on Tropical Cyclones	Panel News. 1981*. 1982*. 1983*. 1988. 1989. 1990.

C. Operational Hydrology

WMO-No. 655 Operational Hydrology	Tropical Hydrology. 1987.
WMO-No. 704 Operational Hydrology	Hydrological Aspects of Combined Effects of Storm Surges and Heavy Rainfall on River Flow. 1988.

* Out of print